

REMARKS

The specification has been amended to include the statement that "The wafer may be rotated to promote uniform distribution of the boundary layer, as well as helping to define the thickness of the boundary layer through centrifugal force." This statement is incorporated by reference from the fourth paragraph up from the end of the parent application 09/621,028, or from Col. 16, lines 53-56 of the corresponding Patent No. 6,869,487. The parent application 09/621,028 is incorporated by reference at 0001.

Claims 20-24, 33-36 and 42-50 are pending. Claim 44 has been amended to provide antecedent basis. Claims 43, 45, and 50 have been further amended to describe providing a substantially uniform liquid layer.

Turning to the prior art, the principle reference EP 782177 is different from the claimed methods, in both the physical steps and the chemical steps performed. Relative to the physical steps, EP 782177 teaches away from controlling the thickness of the liquid layer, and use of a uniform liquid layer, as claimed, because it discloses conducting a single stream of water from a side outlet 11 onto the center of spinning wafer (page 2, line 56, and Fig. 1). Use of a single stream as in EP 782177 would clearly tend to result in a non-uniform liquid layer. The liquid layer in EP 782177 would be thick near the center and much thinner near the outer edges of the wafer. The liquid layer would be thick at the center because that is where the liquid is delivered in bulk. See Fig. 1. The layer would also be thick at the center of the wafer because little or no centrifugal force acts on the liquid there. The liquid layer would be thin near the edges because no liquid is delivered near the edges;

because the liquid flowing outwardly from the center toward the edges necessarily is spread out over a much larger area; and because centrifugal force acts strongly on the liquid near the edges, causing it to accelerate off of the wafer.

Although EP 782177 describes that rinse time, spin rate and/or water flow rate may be adjusted (page 3, lines 56-58), there is no mention of a uniform liquid layer, or controlling a thickness of a layer of liquid on the wafer, as claimed. Indeed, in EP 782177, the spinning is performed only to control the rinse step, without regard to the uniformity or thickness of a liquid layer on the wafer, as claimed. See EP 782177, page 2, lines 55-59; page 3, lines 22-26 and 56-57.

Relative to the chemical steps involved, the objective in EP 782177 is etching silicon oxide, not removing silicon in bulk to thin a wafer. Page 2, lines 12-15; page 3, lines 18-20; the Abstract; and claim 1. The silicon oxide is removed to provide a clean surface for subsequent processing. The oxide layers removed in EP 782177 are generally e.g., 1-2 nm thick. The wafer is e.g., 500,000 to 1,000,000 nm thick. Hence, removing a 1-2 nm oxide layer results in an insignificant change in thickness (of about .0002%). This is not wafer thinning. EP 782177 has no suggestion of wafer thinning, as claimed. To the contrary, the motivation in both EP 782177 is to remove only the organic or oxide layer, and leave all other layers, including the silicon itself entirely untouched.

EP 782177 also teaches away from the methods of claims 42 and 50, which include backgrinding or plasma etching. After being exposed to backgrinding or plasma etching, a wafer surface would not require removal of stray oxide, as

performed in EP 782177, since either of these processes would have already removed it.

Park describes a process for fabricating a semiconductor device and, more particularly, for using a mixture phase of ozone gas, anhydrous HF gas, and deionized water to control the etch selection ratio between oxide film and polysilicon film. Thus, the process described in Park is directed to fabrication of a semiconductor device on a semiconductor wafer. Park does not teach or suggest thinning a wafer.

Even if EP '177 and Park are combined, the result would be a method for removing silicon dioxide and polysilicon using anhydrous HF and ozone with water vapor, followed by a rinse which may use anhydrous HF and ozone. There is no teaching or suggestion in the combination of thinning a wafer, or to thin a wafer to approximately 5 to 20% of its initial thickness, or to thin a wafer to 50-100 microns, as recited in claims 42, 45, and 50, respectively. Given this combination, any etching of the wafer itself that might occur in such a process would merely be incidental and very minimal (i.e., the wafer would not be appreciably thinned). Thus, claims 42, 45, and 50 are allowable.

Han et al., US Patent No. 6,740,247 B1, is applied against the claims in the first paragraph 2 on page 3 of the 10/03/2006 Office Action, as an alternative to Park. As noted by the Examiner, Han et al. discloses cleaning and etching methods for removing silicon dioxide layers. However, Han et al. is silent on wafer thinning. The sections of Han et al. cited at the bottom of page 3 of the 10/03/2006 Office Action say nothing about wafer thinning. The examples cited in columns 10 and 11

confirm that no thinning is disclosed. Example 2-3 in column 10 results in etching 300 angstroms (0.03 microns) in 3 minutes, equating to a rate of 100 angstroms/minute. The rate in claims 34 and 47 is 50 to 100 times faster. In Han et al., the total amount of material removed is .03 microns. In claims 36, 45, and 50, hundreds of microns of material are removed. Hence, the claimed methods relate to removing thousands of times more material than in Han et al. Han et al. therefore cannot reasonably suggest wafer thinning as claimed. Han et al. also relates only to removing a surface oxide, while the claims relate to removing bulk silicon from the body of the wafer itself.

Both Han et al. and EP 782177 disclose only removing very thin silicon oxide layers. Neither reference contemplates wafer thinning. The combination of Han et al. and EP 782177 accordingly cannot make the claims obvious.

With respect to the rejections over the combination of EP 782177, Park or Han et al., and Schraper or Masumoto, claims 42 and 50 are directed to methods for thinning a wafer, wherein an initial backgrinding or plasma etching step is performed, followed by chemical thinning with HF and ozone. Schraper and Masumoto may disclose backgrinding, but they make no suggestion of following such a process with a chemical thinning process, as claimed.

In view of the foregoing, it is submitted that the claims are in condition for allowance. A Notice of Allowance is therefore requested.

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